

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS, Revision A

Meeting #17

Two Low Density Environments

Presented by William Harman

SUMMARY

The material in this paper is offered in support of a MOPS comment that I submitted regarding the two Low Density environments reported in Appendix P. I am proposing to add near the end of section P.4 a brief comment telling the difference between the two Low Density cases that we evaluated.

Two Low Density Environments

The MASPS defines two standard traffic environments for which the performance requirements apply, LA2020 and the Low Density environment. In the WG-3 evaluation of performance, it was necessary for us to determine the fruit environment that corresponds to the air traffic density. Fruit rate and number of aircraft are related by the per-aircraft fruit transmission rate.

PER-AIRCRAFT FRUIT RATE

For a number of years, Lincoln Laboratory, the FAA Tech. Center, and other organizations have made airborne measurements of the interrogation rate received airborne. Received interrogations are a good indicator of the per-aircraft fruit rate, because apart from squitters, all fruit is triggered by interrogations. The measured rates are documented in the following technical reports.

[1] "Beacon Radar and TCAS Interrogation Rates: Airborne Measurements in the 1030 MHz Band, Technical Rept. ATC-239, W. Harman and M. Brennan, May 1996.

[2] "Measurements of 1090 MHz Extended Squitter Performance in the Los Angeles Basin," DOT/FAA/ND-00/7, May 2000.

[3] "Measurements of 1090 MHz Extended Squitter Performance and the 1030/1090 MHz Environment in Frankfurt, Germany," DOT/FAA/ND-01/1, May 2001.

[4] "Airborne Measurements of ATCRBS Fruit," Technical Report ATC-84, W. Harman, Oct. 1978.

In the 4th of these reports, the overall average interrogation rate was determined by comparing the received fruit rate and aircraft density. The conclusion in this report is that a per-aircraft fruit transmission rate of 75/sec. is consistent with the observed aircraft density and total Mode A/C fruit rate, applicable to all of the locations in which the measurements were conducted, including Boston, Philadelphia, Washington DC, and Los Angeles.

Looking at the measurements in more detail, one sees peak interrogation rates around major cities, while the per-aircraft fruit rate is more stable because it is affected by a large number of aircraft over a substantial geographical area. The measurements can be summarized by saying that the per-aircraft Mode A/C fruit rate is about 75 per second in the immediate vicinity of major cities, and about 50/sec. or lower away from major cities.

Figure 1 shows the received fruit rate and power distribution for the Low Density traffic model, using two possible values for the per-aircraft fruit rate, 50/sec. and 200/sec. This is a log-log plot, so you can see the uniform-in-range behavior, which is a 2:1 change in fruit rate for each 3 dB change in received power. The figure indicates that the realistic per-aircraft fruit rate of 50/sec. causes the total reception rate to be about 1250 fruit/sec. for -84 dBm. On the other

hand, increasing the per-aircraft fruit rate by a factor of 4 leads to a total reception rate of about 5000/sec., which is the model we have been using until recently.

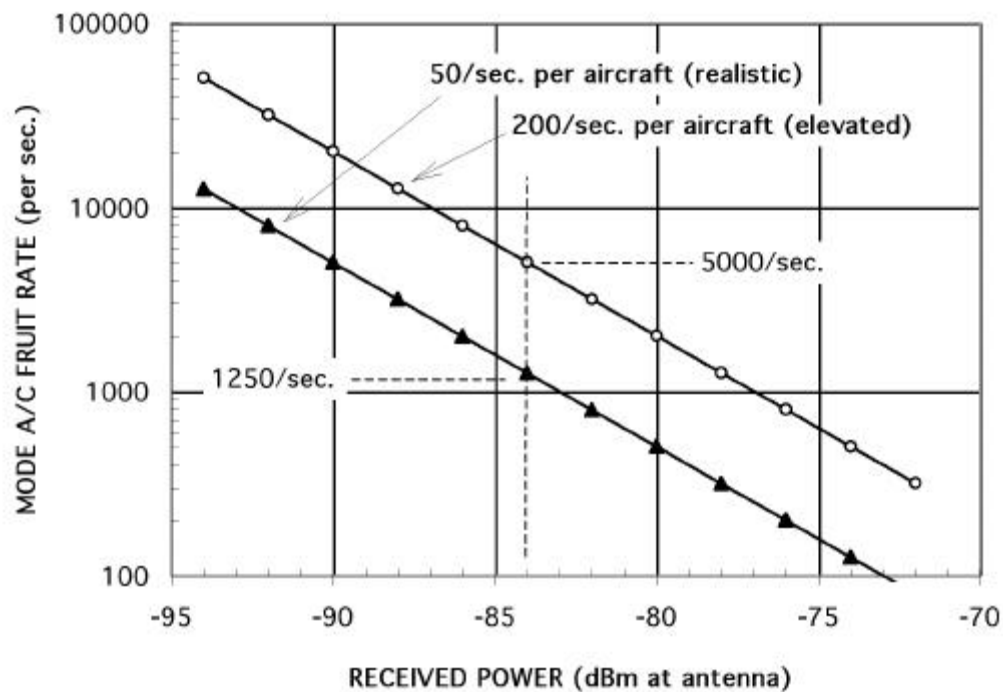


Figure 1. The relationship between per-aircraft fruit and total fruit.

PROCESS

In WG-3, we adopted a fruit rate of 5000/sec. at -84 dBm for the Low Density environment, months ago and somewhat arbitrarily. The inconsistency between this total fruit rate and the known values of interrogation rate was not noticed until after our December meeting. Therefore I believe it was reasonable to release the final version of Appendix P in January without this clarification. Now that these facts are available, I propose adding this clarification to the MOPS, in the form of a small wording change at the end of section P.4. The performance results for both cases are already in the MOPS, so all that is needed now is a brief explanation of the difference between the two cases. Instead of giving the impression that these are just two cases, "case 1" and "case 2", I propose that we add an explanation such as: "(1250/sec. and 5000/sec., the first corresponding to the aircraft density defined in the MASPS, and the second somewhat elevated)."

Note that this is a minor issue, and could be deferred until other issues are taken care of.